Aquaflex Universal Soil Moisture Sensor (Model SI.162-mA) -User Manual- mA Version -

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The AQUAFLEX Universal Sensor (part # SI.162) uses the unique AQUAFLEX measurement technique using a 3m (10') long flexible tape to measure a volume of 6 litres (370 cubic inches) of soil.

The Aquaflex Universal Sensor (mA Version) has two separate 4 to 20mA outputs of soil moisture (in volumetric percent), and soil temperature. These outputs facilitate easy connection to dataloggers, irrigation controllers, telemetry systems etc.

These signals may be used separately or simultaneously at any time without any changes to the sensor

Sensor Installation

Recommendations for sensor installation are given below. Your local AQUAFLEX Distributor will be pleased to give advice about the most suitable method of installation for your application.

It is important that the sensor serial number and the location of the sensor are recorded – see Page 6

There are two main methods for installing the sensors, the choice of which to use depends on the required installation depth for the sensor.

- For shallow installation (eg turf applications) the sensor can be simply 'slit' into the turf.
- For installations deeper than 100mm a trench should be dug for the sensor.

Installation Hints

- Always unroll the data cable. Pulling cables off the side of a roll results in the cable coiling, which makes it difficult to install in the trench.
- Install the data cable in a metal or plastic conduit if there is risk of damage from spiking etc. **NOTE: The flat sensor cable must not be similarly protected**.
- Ensure that the sensor cable is at least 150mm away from any foreign objects.
- Make sure you install in a place that will give readings that are representative for the whole irrigation area.
- If you have any questions please call Streat Instruments (see footer below) or your local agent.

Shallow Installations (e.g. Turf)

1. Select and mark the position of the sensor with a string line. **Position the sensor where it can be easily located in future** – e.g. on a marker line on a sports field or in a position on a golf green marked by sight markers (e.g. between two known points).
2. **Note:** If the soil is sandy, it is easier to install the sensor when the soil is wet, because it holds together better.
3. With a turf cutter or sharp, flat blade, carefully cut a slit in the turf.
4. Carefully insert the sensor into the slit to the desired depth. Note: The sensor must be installed on its edge.
5. For the electronics block at the end of the sensor, carefully peel back sufficient turf to create a slightly larger and deeper cavity in which to bury the block. Fold the turf back.
6. Gently push from behind each side of the slit to close it. Pack from the sides to recreate original density and remove air pockets.
7. Repair and smooth as necessary.
8. Apply a liberal amount of irrigation/water to allow the sensor to bed in and remove air pockets.
9. Run the data cable in a slit or trench to the desired location (e.g. the Datalogger or Controller).

Note: ensure that the cable is buried deep enough to avoid damage during maintenance.

Run string line and cut a slit in turf

Push sensor to desired depth

Completed Installation

Deeper Installations (e.g. Agriculture or Vineyard)

If you have any questions please call Streat Instruments or your local agent.

Make sure you install in a place that will give readings that are representative for the whole irrigation area.

Please note that we recommend that the Aquaflex data cable is installed 90 degrees from the fence line and the Aquaflex sensor runs parallel with the fence. (See Figure 1.0 below).

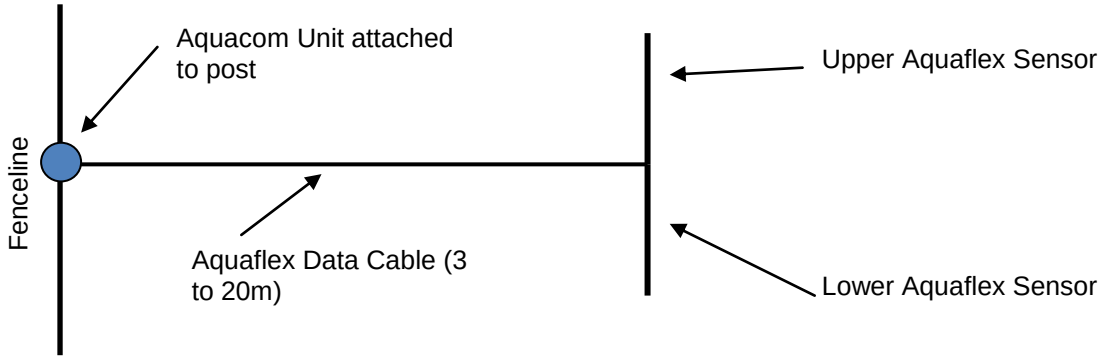


Figure 1 Aquaflex Installation Diagram

Installing the data cable

1. Dig a data cable trench 400-500 mm deep from the base of the post out into the paddock. This trench may be 3 metres, 10 meters or 20 metres long depending on the length of data cable supplied with the Aquaflex. Remove the turf and place on one side of the trench and the soil on the opposite side.
2. Lay the data cable in the bottom of the trench and cover it with soil. Compact down with feet as you go so that the cable is flat and straight along the bottom of the trench.
3. Connect the sensor(s) to the datalogger or controller (see details in Electrical connections, below).
4. Use the cable ties to keep the data cable against the post so that cows or other animals don't chew it.
5. Near the AQUAFLEX end leave the ditch open as it is easier to install the AQUAFLEX with flexibility in the data cable.

Installing the Upper Aquaflex Sensor

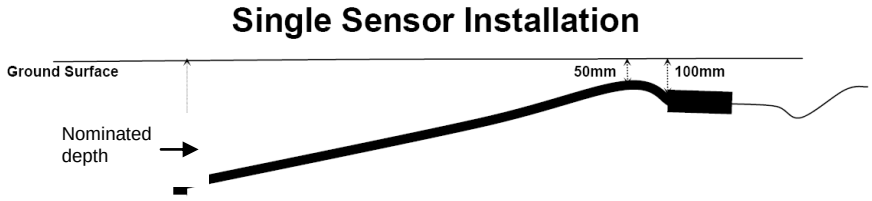
Refer to Figure 1 for the location of the trench for the Upper Sensor.

When digging the data cable trench take note of how deep the topsoil is and where the majority of the roots are.

The top sensor should only be installed within the majority of the root zone and within the topsoil – as a general rule we install the sensor to 300 mm at the deepest. This removes the effect that a sub soil with different water holding capacity can have on the moisture measurement as the Aquaflex takes an average over the whole sensor.

1. Lay a plastic sheet or similar alongside the area where the trench is being dug. Dig out the turf and lay on the opposite side from the plastic sheet. If soil is falling from the turf then it would be advisable to lay the turf onto the plastic sheet.

2. Start at the shallow (box end). Dig down to 50mm. The box contains the thermometer so needs to sit at 100 mm depth to give a standard temperature reading.
3. Remove the soil in its natural layers/horizons and lay it out on the plastic sheet. Dig a sloping trench from 10cm to the bottom of the topsoil across the 3 metre length of the Aquaflex Sensor.



4. Once the trench has been dug make sure that the bottom of the trench is on an even slope.
5. Lay the Aquaflex Sensor down in the trench in its edge (so that water cannot sit on the top of the sensor).
6. Shovel the soil back into the trench placing it around the sensor to give good contact with the sensor. Make sure you apply the right layer of soil and stones in the appropriate order. Move the soil around before packing it down to ensure any air gaps have been filled in by loose aggregates.
7. Pack tightly with either your feet or post hole rammer depending on the surrounding soil profile – you want the soil to return to its original density as best as possible. Make sure that you don't ram or stand on the Aquaflex as it may bend over or be damaged.
8. Stones are to be replaced in the trench as best as possible, **not** directly beside or on the sensor as this may cause air gaps and possible sensor damage. Place the stones in the trench where they will not cause damage to the sensor with compaction.
9. Insert a paver at each end of the Aquaflex sensor (put 200 mm further out than the 'real' end)

Installing the optional lower sensor
Refer to Figure 1 for the location of the trench for the Lower Sensor (in the opposite direction to where the Upper Sensor is installed from the end of the data cable trench).

1. As with the upper sensor, remove the soil in its natural layers/horizons.
2. Dig the soil out in the determined layers and lay out on a plastic sheet ensuring that the soil layers do not get mixed up.
3. Dig the trench to a depth which is below the root zone - this is most often 500mm in a grass pasture.
4. The lower sensor usually gets installed horizontally at one depth (ie not on a slope)
5. Follow steps 5 to 9 as above.
6. Once the Aquaflex trench has been filled, complete filling the cable trench and replace the turf.

Helpful Pictures

Soil removed and placed in three layers.

Top sensor installed to 250mm at the deep end.

Documentation

1. AQUAFLEX Records

Sensor 1 S/no.: _____

Sensor 2 S/no.: _____

Sensor 1 Depth: 50 to _____ mm

Sensor 2 Depth: _____ mm

Sensor Cable Length: _____ m

Top sensor installed to (depth): _____ mm

Topsoil depth: _____ mm

Topsoil Type: _____

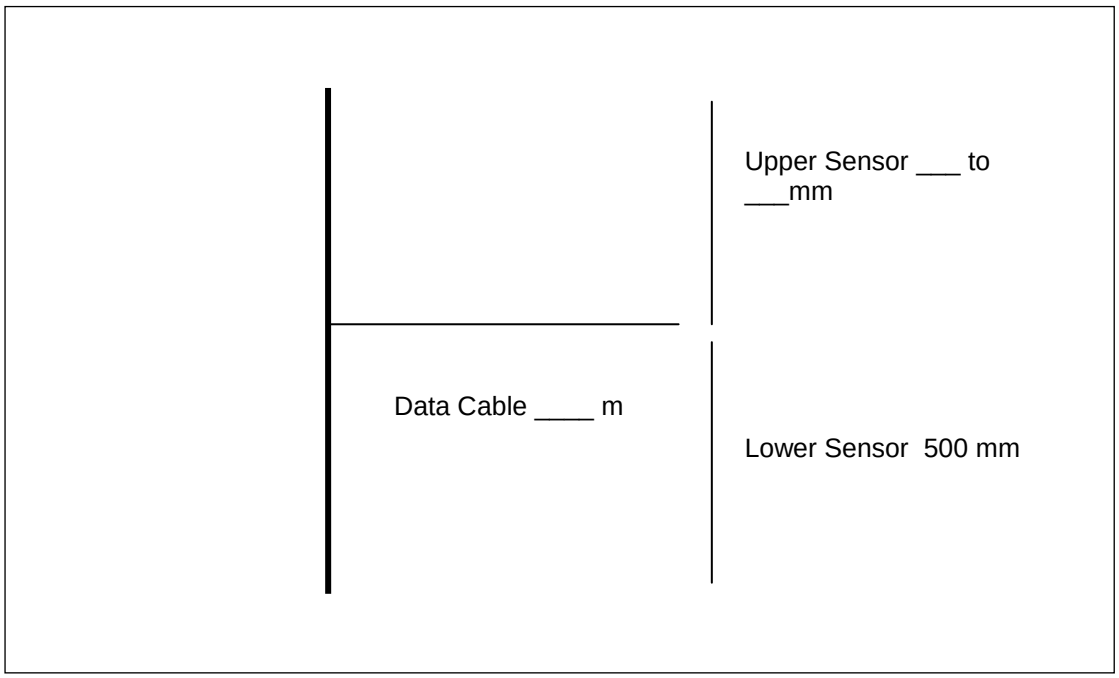
Topsoil Stone size: _____ mm

Topsoil Stone %: _____

Subsoil Type: _____

Subsoil Stone size: _____ mm

Subsoil Stone %: _____



Please draw an Arrow to show North on the diagram.
Note the upper and lower can be installed in either direction.

Converting the Signal to Soil Moisture or Temperature

4 - 20mA Outputs

For sand, silt and sandy and silty loams:

Moisture (%) = 3.75 x C - 15

For clay and clay loams:

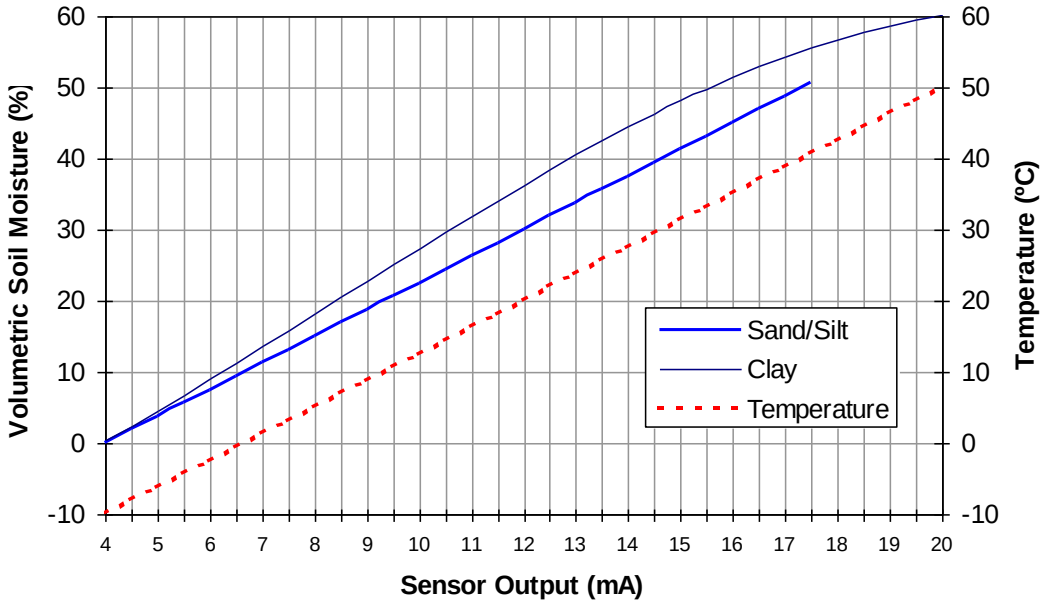
Moisture (%) = -14 + 2.87 x C + 0.214 x C^2 - 0.0086 x C^3

For temperature:

Temp (°C) = 3.75 x C – 25

Where C is the output current in mA.

Aquaflex 4 - 20mA Sensor Calibration Graph



When a 125Ω Resistor is Used to Convert the 4 - 20mA Signal to a 0.5 to 2.5 volt Signal

For sand, silt and sandy and silty loams:

Moisture (%) = 30 x V - 15

For clay and clay loam soils:

Moisture (%) = -14 + 23 x V + 13.7 x V^2 - 4.4 x V^3

For temperature:

Temp (°C) = 30 x V - 25

Where V is the output voltage.

Electrical Connections

Wire Colour	Description	
Red	Sensor power +ve, 6.0 to 26 Volts.	
Black	Sensor ground, 0 Volts	
Violet	Not Used	
White	Moisture output, mA +	Moisture output, 4-20 mA.
Blue	Moisture output, mA -	
Brown	Temperature output, mA +	Temperature output, 4-20mA.
Orange	Temperature output, mA -	
Yellow	Factory only, do not connect.	

Note: The Sensor Ground and mA - cores are connected internally within the sensor, therefore this sensor is not suitable for situations that require fully isolated outputs.

Sensor Fault Indicators

If a fault occurs, the sensor outputs special signals, as follows:

Signal (V across 125Ω load)			**Fault condition**
0mA	0 V	0 ppm	A broken wire or possible failure in the sensor. Check the wiring and repair. Contact your distributor if wires are intact.
1 mA	0.125 V	2.5 ppm	Moisture reading out of expected range. If this output continues, contact your distributor. (Note: sensors will often give this output when in air, before burial – this is normal)
2 mA	0.250 V	5.0 ppm	Low battery or supply voltage. Replace the batteries or check power supply.
3 mA	0.375 V	7.5 ppm	Critical sensor settings have been lost. Contact your distributor.

Specifications

Power supply voltage	+6.0 to +26 Volts, DC.
Power supply current	10mA average, 150mA peak (for 60 milliseconds during measurement) **plus** two current loops of up to 20mA each.
4-20mA outputs	**Moisture Output** 4-20mA representing the moisture range 0-60%. **Temperature Output** 4-20mA representing the temperature range -10 to 50 °C. Maximum load resistance ♦ 250 Ω with 9 Volts supply. ♦ 1 kΩ with 24 Volts supply. The 4-20mA signals may be converted to voltage signals by connecting external resistors across the 4-20mA outputs. Using a 125Ω resistor results in a 0.5 to 2.5V range.
Time to measure	1.5 seconds after power supplied (typical). 2 second maximum.
Time between measurements	1 minute, if power applied constantly.
Operating Temperature	-10 to 40°C (14 to 104°F)
Soil Moisture Measurement	
Range	0 to 60% volumetric moisture content
Precision / Repeatability	± 0.5% volumetric moisture content
Accuracy	± 2% volumetric moisture content
Soil Temperature Measurement	The temperature is measured at the body of the sensor, not along the moisture-sensing cable.
Range	-10 to 50°C (14 to 122°F)
Accuracy	± 0.5°C (0.9°F)

Conditions of Use

Aquaflex must be installed as specified. Use of Aquaflex data is entirely at the discretion of the user and should therefore be subject to current best practice principles of soil moisture management and agronomic management.

Neither Streat Instruments nor its Distributors shall be liable (whether in contract, tort or otherwise) for any loss (including but not limited to loss of profits and consequential loss) of any kind whatever arising out of any published material or in connection with the performance or use of Aquaflex.

The serial number marked on each Aquaflex Sensor must be recorded and quoted for warranty claims.

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